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4-38716

MAGNETIC DISK
[Jiki Disuku]

Tetsuo Samoto

UNITED STATES PATENT AND TRADEMARK OFFICE
Washington, D.C. June 2000

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Foreign Language Title	:	Jiki Disuku
English Title	:	MAGNETIC DISK

Specification /1[1]

1. Title of the Invention: MAGNETIC DISK

2. Claims

1. A magnetic disk characterized by the fact that concentric or spiral grooves are formed in a landing zone.

2. The magnetic disk characterized by the fact that the above-mentioned grooves are machined by a powder-beam-etching method.

3. Detailed explanation of the invention

(Industrial application field)

The present invention pertains to a magnetic disk for recording and/or reproduction by a magnetic disk slider.

(Outline of the invention)

In the present invention, the flowing characteristic in a landing zone of a magnetic head slider can be improved by forming concentric or spiral grooves in the landing zone of a magnetic disk.

(Prior art)

In a conventional hard disk device, a contact-start-stop (hereinafter, described as CSS) of the magnetic head slider is carried out in the landing zone installed at the innermost periphery of the magnetic disk. Also, when the CSS is applied,

[1] Numbers in the margin indicate pagination in the foreign text.

an adsorption phenomenon (when specular surfaces are adhered, they are adsorbed to each other) causes a problem.

Accordingly, in a conventional example described in Japanese Kokai Patent Application No. Sho 61[1986]-3322, as shown in Figures 5 and 6, the surface roughness of a laminar landing zone 3 formed at the inner periphery of a read-write zone 2 is greater than the surface roughness of the read-write zone 2 on the surface of a magnetic disk 1. /2

Then, as shown in Figure 5, at a time of contact-stop, a magnetic head slider 4 is press-contacted on the landing zone 3, whose surface is rough, by a spring load of a load beam 5, so that the adsorption phenomenon of the magnetic head 4 to the magnetic disk 1 is prevented, thereby being able to smoothly rotate and drive the magnetic disk 1 at the time of contact-start.

Also, in the conventional example, as shown in Figure 6, in a state in which the magnetic disk 1 is rotated and driven, an abrasive tape 6 is press-contacted into the landing zone 3, and the abrasive tape 6 is slid in the radial direction (arrow a and a' direction) of the magnetic disk 1, so that the inside of the landing zone is polished.

(Problems to be solved by the invention)

However, in the conventional example, the floating characteristic of the magnetic head slider 4 at the time of

contact-start could not be expected.

In other words, at the time of contact-start, with the rotation of the magnetic disk 1, an air flow being generated on the surface is introduced between the magnetic head slider 4 and the magnetic disk 1, and the magnetic head slider 4 is floated upward from the landing zone 3 against the spring load of the load beam 5 by the air flow.

However, as shown in Figure 5, the ordinary magnetic head slider 4 being most frequently used in hard disk devices, for example, as seen in Japanese Kokai Patent Application No. Sho 61[1986] - 57087, is a twin body type in which grooves 4b are formed in the middle of parallel twin body parts 4a, and a slider surface 4c, which is an opposite surface of the magnetic disk 1 of the twin body part 4a, is horizontally formed. At the tip of the slider surface 4c, an inclined surface 4d is formed, and at the side opposite to the inclined surface 4d, a magnetic head chip 4e is arranged. Also, the slider surface 4c and the inclined surface 4d are finished like a mirror.

Therefore, as shown in Figure 5, in a state in which the magnetic head slider 4 is press-contacted parallel with (horizontally to) the landing zone 3 by a slider surface 4c, when the magnetic disk 1 is rotated and driven in the arrow b direction, the air flow being generated on the surface of the magnetic disk 1 is difficult to be introduced between the slider

surface 4c and the landing zone 3, and the magnetic head slider 4 is not easily floated. Then, when the rotational speed of the magnetic disk 1 is raised to some degree, a prescribed amount of air flow is introduced between the sliding surface 4 and the landing zone 3, so that the magnetic head slider 4 is floated upward from the landing zone 3.

Therefore, in the conventional example, not only the time required for floating of the magnetic head slider 4 at the time of contact-start was long, but the landing zone 3 with a rough surface rubbed the slider surface 4c, so that the slider surface 4c finished like a mirror was easily damaged.

Also, in the conventional example, as shown in Figure 6, since the landing zone 3 was polished by sliding the abrasive tape 6 in the radial direction (arrow a and a' direction) of the magnetic disk 1 while rotating and driving the magnetic disk 1, a central area 3a of the landing zone 3 corresponding to the width W_1 of the abrasive tape 6 can be completely polished up to a prescribed surface roughness, however both inner and outer side areas 3b of the central area 3a corresponding to the slide width W_2 of the abrasive tape 6 are incompletely polished, so that polishing up to a prescribed surface roughness cannot be realized. Therefore, in both inner and outer side areas 3b, the adsorption phenomenon of the magnetic head slider 4 cannot be prevented, and these both inner and outer side areas 3b become

useless areas. For this reason, the entire width ($W_1 \cdot 2W_2$) of the landing zone 3 was considerably large, compared with the width of the magnetic head slider 4, so that the surface of the magnetic disk 1 could not be effectively utilized in the read-write zone. In particular, such zones could not be applied to a small-scale magnetic disk with a diameter of 2.5 inch.

The purpose of the present invention is to provide a magnetic disk that can improve the floating characteristic of a magnetic head slider while preventing the adsorption phenomenon of the magnetic head slider and can form the width of the landing zone as a minimum width with respect to the width of the magnetic head slider.

(Means to solve the problems) /3

In order to achieve the above-mentioned purpose, according to Claim 1 of the magnetic disk of the present invention, concentric or spiral grooves are formed in a landing zone.

According to Claim 2, the above-mentioned grooves are machined by a powder-beam-etching method.

(Operation)

In Claim 1 of the magnetic disk with the above-mentioned constitution, at a time of contact-start, with the circulation of air in the concentric or spiral grooves formed in the landing zone, the adsorption phenomenon of the magnetic head slider to the magnetic disk can be prevented. Furthermore, at the time of

contact-start, from the moment when the magnetic disk is rotated and driven, since the magnetic head slider can be instantly floated by introducing the air flow into the concentric or spiral grooves formed in the landing zone, the floating characteristic of the magnetic head slider can be improved.

In Claim 2, since the concentric or spiral grooves being formed in the landing zone 2 are machined by the powder-beam-etching method, the above-mentioned grooves can be easily and precisely formed within the width of the landing zone, so that no useless area is generated in the landing zone.

(Application example)

Next, an application example, in which the present invention is applied to a magnetic disk of a hard disk device is applied, is explained referring to Figures 1-4.

The width W_3 of the landing zone of the magnetic disk is formed as a width slightly greater than the entire W_4 of the magnetic head slider 4, that is, as a minimum width with respect to the width W_4. Then, the width W_3 of both inner and outer side areas 3b of the landing zone 3, to which a pair of slider surfaces 4c of the magnetic head slider 4 of [illegible] type are press-contacted, is slightly greater than the width W_4 of the slider surfaces 4c, and several concentric or spiral grooves 8 are formed on the surface of these both inner and outer side areas 3b. Also, the above-mentioned grooves 8 may also be formed

on the surface of the central area 3a to which the slider surfaces 4c of the landing zone 3 are not press-contacted, however the surface of the central area 3a may also remain as a specular surface as it is.

Also, if the width W_4 of each slider surface is A, the pitch of the grooves 8 is P, the width of the grooves 8 is W, and the depth of the grooves 8 is d, conditions of $p < A/2$, $P/2 < W < P$, and $d > 0.1\ \mu m$ are established. It is desirable for each slider surface 4c to be press-contacted to at least two or more grooves 8.

In addition, as a numerical value example, when the width W_3 of the landing zone 3 was about 3.2 mm, it was assumed that A was about 0.36 mm, P was about 0.15 mm, W was about 0.12 mm, and d was about 1 μm.

On the other hand, the machining process sequence of the magnetic disk 1 is (1) mirror-like processing of the entire surface, (2) processing of the grooves 8 by the powder-beam-etching method, (3) washing, (4) formation of a magnetic film, and (5) spreading of a lubricant, for instance.

Accordingly, processing of the grooves 8 by the powder-beam-etching method is explained by Figures 4A and 4B.

First, in the processing method of Figure 4A, an injection port 10b with a diameter of 0.1 mm of an injection nozzle 10 is made to approach at a height of H_3 of about 1 mm to the surface

of the landing zone 3, and a solid-gas mixed two-phase flow 9 of particulates such as silicon carbide (SiC) with a diameter of about 5 μm and a high-pressure gas (air, dry nitrogen, etc.) is injected at a high speed of about 10-100 m/sec and an angle to the surface of the landing zone 3 from the injection port 10b of the injection nozzle 10, so that the grooves 8 are mechanically etched. At that time, in a state in which the injection port 10a is made to approach at a height of H_3 of about 1 mm to the surface of the landing zone 3, the magnetic disk 1 is rotated about 8 times at about 0.7 rpm. /4

In the meantime, while injecting the solid-gas mixed two-phase flow 9 at high speed to the surface of the landing zone 3 from the injection port 10a of the injection nozzle 10, the injection nozzle 10 is continuously moved at about 2 μm/sec in the width direction (arrow c direction) of the landing zone 3, so that the spiral grooves 8 are formed. Also, in case the concentric grooves 8 are formed, the solid-gas mixed two-phase flow 9 is intermittently injected from the injection nozzle 10 while intermittently moving the injection nozzle at a fixed pitch P in the arrow c direction. This processing method is completed in about 11 min.

Next, in the processing method of Figure 4B, first, as a pretreatment process, a resist 11 is spread on the entire surface of the magnetic disk 1, and a spiral or concentric groove pattern

12 is spread on the entire surface of the magnetic disk 1. The spiral or concentric groove pattern 12 is exposed to the landing zone 3 of the resist 11. Next, the oblong injection port 10a with an injection nozzle width of about 0.6 mm and a length of about 10 mm is made to approach at a height of H_3 of about 10 mm to the surface of the landing zone 3, and the magnetic disk 1 is rotated about once at about 4 rpm. In the meantime, the solid-gas mixed two-phase flow 9 is injected at high speed of about 10-100 m/sec to the groove pattern 12 of the resist 11 from the injection port 10b of the injection nozzle 10, and the spiral or concentric grooves 8 are mechanically etched along the bottom of the groove pattern 12. Then, the etching is completed by removing the resist 11. Also, the time required for etching the grooves 8 is about 15 sec.

According to the magnetic disk 1 with the above constitution, at the time of contact-stop, as shown in Figures 1-3, the slider surface 4c of the magnetic head slider 4 is press-contacted onto several grooves 8 of the landing zone 3 of the magnetic disk 1 by the spring load of the load beam 5.

However, in the press-contacted state, with the circulation of air in several grooves 8, the adsorption phenomenon of the slider surface 4c of the magnetic head slider 4 to the landing zone 3 of the magnetic disk 1 is prevented.

Next, at the time of contact-start, as shown in Figure 3,

from the moment when the magnetic disk 1 is rotated and driven in the arrow b direction, the air flow is introduced in the arrow d direction into several grooves 8, and the floating force can be instantly generated in the slider surface 4c of the magnetic head slider 4. Thus, when the magnetic disk 1 is rotated and driven in the arrow b direction, the magnetic disk slider 4 can be floated from the landing zone 3.

Hereto, the application example of the present invention has been mentioned, however the present invention is not limited to the above-mentioned application example but can be effectively variously modified based on the technical concept of the present invention.

(Effects of the invention)

The present invention exerts the following effects due to the above-mentioned constitution.

According to Claim 1, with the concentric or spiral grooves formed in the landing zone, the adsorption phenomenon of the magnetic disk at the time of contact-stop is prevented, and at the time of contact-start, when the magnetic disk is rotated and driven, the magnetic head slider can be floated, so that the floating characteristic of the magnetic head slider is improved. Thus, the time required for floating the magnetic head slider at the time of contact-start can be largely shortened, and in the meantime, the friction between the landing zone and the slider

surface of the magnetic head slider can be reduced. Thereby, damages of the above-mentioned mirror-like finished slider can be prevented.

According to Claim 2, since the concentric or spiral grooves being formed in the landing zone are machined by the powder-beam-etching method, no useless area is generated in the landing zone, and the landing zone can be formed at a minimum width with respect to the width of the magnetic head slider. In particular, a small-scale magnetic disk with a diameter of 2.5 inch can also be sufficiently applied. Also, the method for machining the grooves by the powder-beam-etching method has a very short machining time.

4. <u>Brief description of the figures</u> <u>/5</u>

Figures 1-4 show an application example of the present invention. Figure 1 is a cross section of A-A line of Figure 2, showing the main parts. Figure 2 is a bottom view showing the main parts. Figure 3 is a cross section of B-B line of Figure 2, showing the main parts. Figures 4A and 4B are cross sections showing the main parts of the powder-beam-etching method.

Figure 5 is a cross section showing the main parts of a conventional example. Figure 6 is a bottom view showing the main parts of the magnetic disk 1 of a conventional example.

Also, the symbols used in the figures are as follows.

1 Magnetic disk

3 Landing zone

4 Magnetic head slider

4c Slider surface

8 Groove

9 Solid-gas mixed two-phase flow

10 Injection nozzle

Figure 1: Main parts

1 Magnetic disk

3 Landing zone

4 Magnetic head slider

4c Slider surface

8 Groove

Figure 3: Main parts

Figure 2: Main parts

Figure 4A: Powder-beam-etching method

9 Solid-gas mixed two-phase flow

10 Injection nozzle

Figure 4B: Powder-beam-etching method

Figure 5: Conventional example

Figure 6: Polishing of a conventional example

第1図～第4図は本発明の一実施例を示したものであって、第1図は要部を示す第2図のA－A矢視での断面図、第2図は要部を示す平面図、第3図は要部を示す第2図のB－B矢視での断面図、第4A図及び第4B図はパウダー・ビーム・エッチング法を示す要部の断面図である。

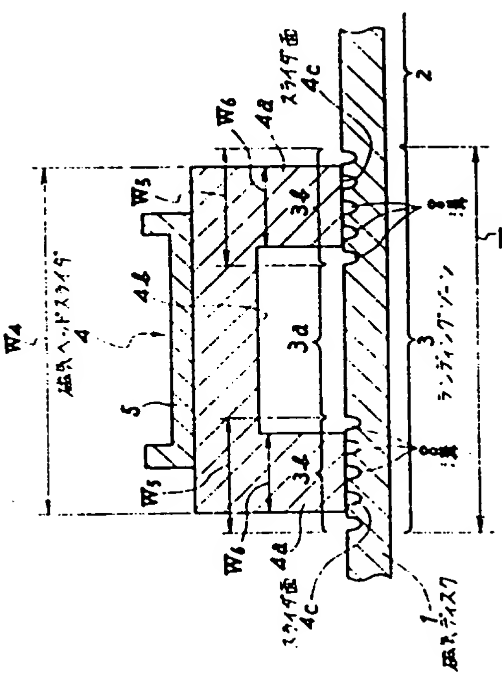
第5図は従来例の要部を示す断面図、第6図は従来例の研摩加工を示す要部の平面図である。

なお、図面に用いられた符号において、

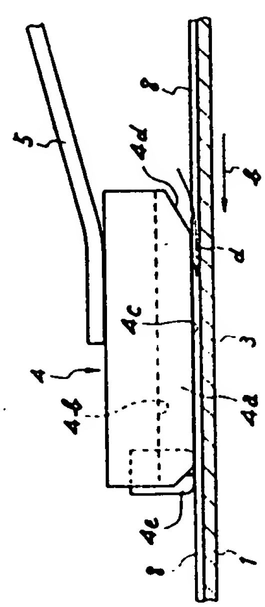
1	磁気ディスク
3	ランディングゾーン
4	磁気ヘッドスライダ
4c	スライダ面
8	溝
9	閉気混合2相流
10	噴射ノズル

である。

代理人 弁理士 [illegible]



要部
第1図



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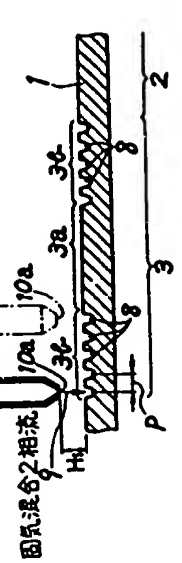
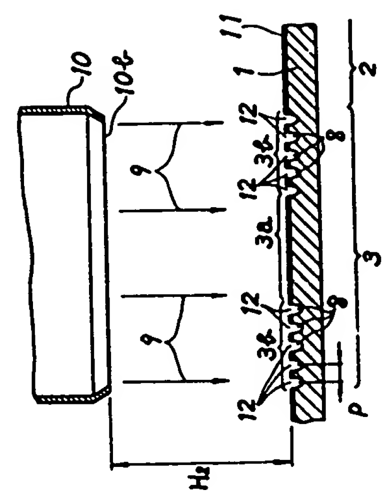
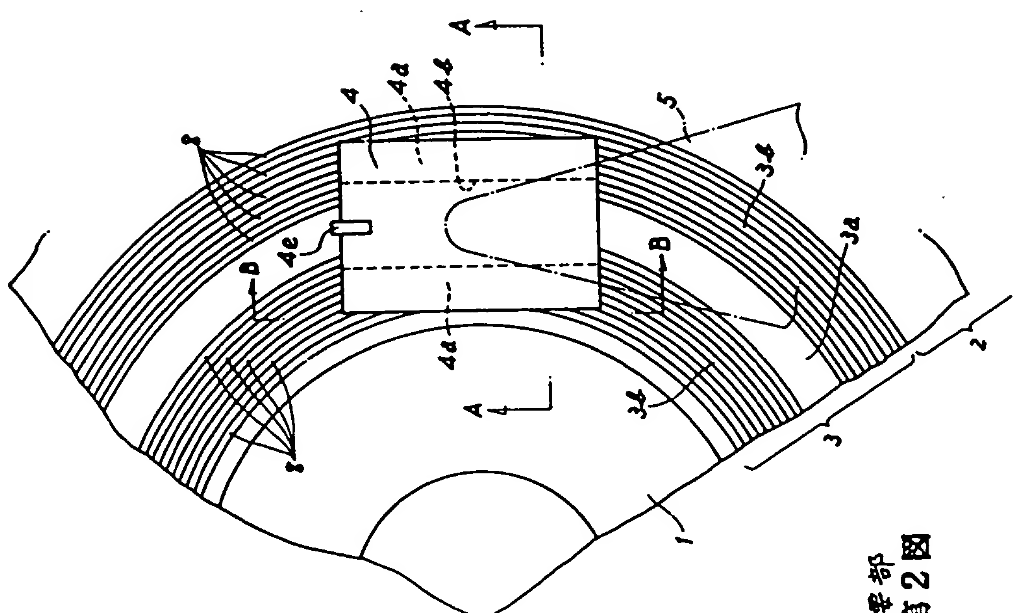
第3図



パウダー・ビーム・エッチング法
第4A図



パウダー・ビーム・エッチング法
第4B図



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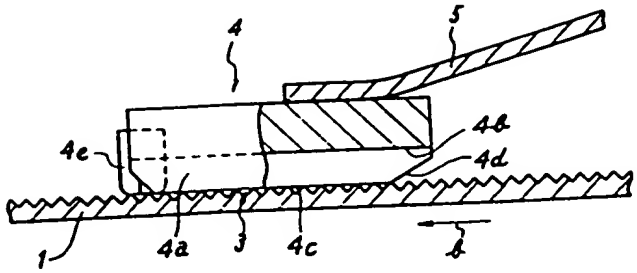
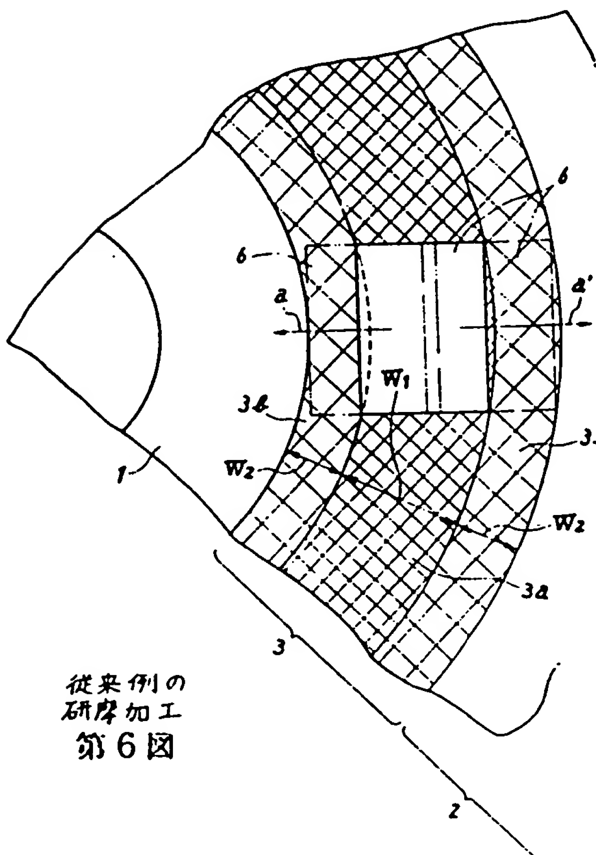
第2図



従来例
第5図



従来例の
研摩加工
第6図